Landfill Gas and Leachate Collection System Operations, Maintenance, and Monitoring Plan

Mallard North Landfill

January 2010

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Prepared For
Forest Preserve District of DuPage County

Jan C. Kucher, P.E.
Senior Engineer

Alan J. Schmidt
Project Manager

Jason Schoephoester
Environmental Scientist

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Section 1
Introduction

1.1 Purpose and Scope

This Operation, Maintenance, and Monitoring (O,M&M) Plan provides guidelines for the short and long-term operation, maintenance, and monitoring of the landfill gas (LFG) collection system (LFGCS), leachate collection system (LCS), and the landfill cover at the Mallard North Landfill (MNL) located in Hanover Park, Illinois. The Forest Preserve District of DuPage County (District) owns the site and intends to implement the O,M&M. The components addressed in this O,M&M Plan are as follows:

- System equipment
- System monitoring
- Landfill gas collection system
- Leachate collection system
- Landfill cover
- Reporting

This O,M&M Plan will be supplemented by the Landfill Cover Repair and Landfill Gas Collection System Documentation Report once the LFGCS construction is completed and system startup activities have concluded. Since this O,M&M Plan has been prepared prior to LFGCS construction completion, the record construction documentation drawings and contractor submittals will be included in the Documentation Report. This plan may require modification if significant modifications to the initial LFGCS Design Report occurs. The site-specific Health and Safety Plan (HSP) should be reviewed to obtain historical and construction safety–related information.

The purpose of this O,M&M Plan is to provide guidelines for the operation and maintenance of the MNL system components. It is not intended to be a substitute for proper training and experience. On-site training and experience with the system components will be required to complement the information in this plan. Modifications will be incorporated in the plan to accommodate changes in system operations and manufacturers' information as system components are replaced or modified during the operation, maintenance, and monitoring of the system.

1.2 Site Location and Description

The MNL is located in T 40N, R 10 E, Section 7, unincorporated DuPage County, Illinois, near the Village of Hanover Park, approximately 28 miles west-northwest of downtown Chicago. The land on which the MNL is located is currently owned by the District. The site is fenced along the northern side and portions of the western side of the MNL. A concrete wall along the northern boundary extends below ground and runs roughly east-west, separating the MNL from a residential area. A residential housing development includes townhouses (Tall Oaks Subdivision) along the western boundary of the MNL. The West Branch of the DuPage River (WBDR) bounds the landfill on the east, south, and southwest. The Mallard Lake Landfill (MLL), a closed permitted solid waste disposal facility, is located immediately south of the MNL and on the opposite side of the WBDR. A bridge connects the two landfill properties. A hiking and biking trail is located east and south of the MNL.

1.3 General Project Information

This plan describes O,M&M activities to be performed on the LFGCS and LCS components at the MNL. This plan addresses the following subjects as they relate to the landfill cover, leachate collection system, and LFG control system:

- System equipment and operations – Section 2
- System monitoring and process control – Section 3
- System equipment and maintenance – Section 4
- Potential operation problems – Section 5
- Alternate operations and maintenance – Section 6
- Safety plan – Section 7
- Reporting – Section 8
- LFG and LCS routine monitoring – Section 9

Activities related to groundwater monitoring are included in the Groundwater Monitoring Plan submitted to the U.S. EPA in November 2009 and will be modified according to subsequent groundwater monitoring submittals. In addition, the tracking of performance objectives and the corresponding corrective actions will be detailed in periodic updates to Illinois EPA (IEPA) and the U.S. EPA. Long-term goals and remedial objectives were established in fall 2009 based on discussions between the District, U.S. EPA, IEPA and RMT.

Construction activities have been occurring throughout 2009, related to leachate collection, cover repair, and LFG collection. A LCS and solar flares were installed in June and July 2009 and cover repair and LCS activities were performed in September and October 2009. LFGCS

system construction and winterization activities began in December 2009 and are scheduled to conclude in early 2010. The features and components associated with the above activities will require regular inspections, maintenance, and monitoring.

Section 2
System Equipment and Operations

2.1 General

This section provides guidelines for the startup, routine operation, and shutdown procedures for each major system component of the systems in place at the site. The procedures contained herein are not intended to address every possible operating situation and do not provide a substitute for proper training and experience. In conjunction with this O,M&M Plan, the record construction documentation plans are necessary to effectively maintain and operate the systems installed at the MNL.

Proper O,M&M of the LFGCS are essential so that the systems function safely and effectively. The primary operational procedure for the LCS entails keeping the collection pumps, and associated piping in good operating condition and the regulation of the leachate pumping rate from each leachate extraction well. The primary operational procedure for the LFGCS involves regulating and adjusting the applied vacuum and gas flow rate at each extraction well. The procedure is referred to as "balancing" or "tuning" the gas system. A balanced system requires that each well be adjusted to extract the maximum amount of landfill gas possible while maintaining control of migration and without causing an excessive amount of air (atmospheric oxygen) intrusion into the waste and LFGCS.

Detailed manufacturers' operating and maintenance manuals for the various system components are provided in the appendices to this O,M&M Plan. All manufacturers' instructions should be read and understood prior to operating the equipment.

2.2 Landfill Gas Collection System

The LFGCS consists of two separate systems, each targeting an area of concern related to the potential for off-site migration of LFG, and both located within the MNL footprint. One system is located in the southcentral portion of the MNL, and the other is located in the northwestern corner. Buried piping conveys the LFG to a blower/flare system for each of the two systems. Each LFGCS utilizes a modified solar vent flare and a small centrifugal blower. Certain existing gas vents and leachate extraction wells (seven in the southcentral LFGCS and nine (including two new extraction wells) in the northwest LFGCS) are connected to the LFG conveyance piping. Also, as part of the LFGCS installation, one of the solar vent flares (with a solar-powered blower) was moved to gas vent UAV-4. Each LFGCS will be re-evaluated after a period of operation to evaluate its effectiveness, based on the agreed upon objectives and goals

for the MNL to determine if additional gas extraction points or other system modifications are needed. See Figure 1 for a layout of the LFGCS components as they were designed (record construction documentation drawings will be provided following the completion of construction and start-up activities). The LFGCS is described in more detail in the following sections.

2.2.1 Landfill Gas Extraction Wells

The southcentral and northwest LFGCS utilizes the fourteen existing and two recently installed (GEW-1 and GEW-2) gas vents/leachate extraction wells. One of the LFG extraction wells (EWL-2) is a dual extraction (LFG and leachate) and the remaining wells are LFG extraction only; however, these wells are designed so that they can be converted to dual extraction if necessary in the future. The dual extraction wellhead (EWL-2) is located within a vault in the final cover surface. There is potential for surface water to collect in the vault. Surface water collected may be removed by opening the valve located on the small-diameter hose extending from the gas header lateral pipe at the base of the vault. The vacuum in the lateral pipe should be sufficient to draw the water into the lateral where it will be collected with condensate.

A wellhead connects each well to the LFG header pipe to convey the extracted LFG to the blower and flare system. A valve provided at each well controls LFG flow rate and applied vacuum. Monitoring ports are provided on each wellhead for sampling LFG for methane (CH_4), nitrogen (N) as balance gas, oxygen (O_2), carbon dioxide (CO_2), LFG temperature, flow rate, and applied vacuum. Furthermore, the wellhead is designed in such a way that it allows for the potential for future addition of a pneumatic leachate pump, if the need arises. The arrangements of these components and the vault in which they are contained are shown in the record construction documentation drawings.

The objective of the extraction wells is to minimize LFG migration by extracting the maximum amount of LFG from the area surrounding each well while minimizing the amount of oxygen intrusion into the waste. For the LFGCS, the above measurements will determine the performance as follows:

- Vacuum readings confirm that the control valve is open and the vacuum is available to the well.
- CH_4 concentration measurements determine if the well is producing LFG or drawing oxygen into the system.
- Flow measurements quantify the amount of gas production and assist in positioning the valve at each well.

– Temperature and O_2 measurements identify air intrusion and potential underground fire problems.

Refer to Section 3 for detailed wellhead monitoring and adjustment procedures.

2.2.2 Landfill Gas Collection System Piping

The LFG header piping conveys the LFG from the extraction point to the blower/flare system and condensate to the driplegs. The LFG header pipe for both systems is a 4-inch–diameter SDR 17 high-density polyethylene (HDPE) pipe. Additionally, 2-inch–diameter SDR 11 HDPE leachate forcemain pipe and 1-inch–diameter (2-inch-diameter at certain points) SDR 11 HDPE compressed air pipe are installed in portions of the same trench as the LFG collection pipe trench.

2.2.3 Condensate Handling System

Condensate that is collected within the LFG collection piping is drained by gravity to designed low points in the piping system. This condensate must be removed from the LFG header piping system to prevent the liquids from impeding the flow of LFG. Driplegs are used to remove the extremely small amount of condensate expected from the LFGCS piping, and the condensate is conveyed to the existing leachate extraction points, where it is pumped into the leachate forcemain with a pneumatic pump. The pneumatic pump will be operated in accordance with the manufacturer's guidelines included in Appendix B. The pneumatic pumps will be powered by the compressed air supply line from a compressor located in a small building near EWL-2. The condensate dripleg is a negative-pressure dripleg (i.e., it operates under the vacuum pressure of the LFGCS). The dripleg is designed similar to a U-trap in a home plumbing system, but is constructed for a specific design vacuum pressure (refer to the record construction documentation drawings). The design allows condensate to drop out of the LFG header pipe while vacuum is maintained in the LFGCS.

Prior to placing the driplegs into operation and after any work on the driplegs, the liquid level in the dripleg "trap" should be checked, and water added if necessary, to so that no ambient air is drawn into the LFGCS. The liquid level can be checked by shutting down the LFGCS blower, removing the threaded cap on the dripleg riser that contains the LFG header pipe, and using a water level indicator to check for the presence of liquid. Under normal circumstances, the operation of the dripleg is completely automatic and requires little maintenance.

2.2.4 Blower/Flare System

Each LFG blower/flare system includes a single vacuum blower, a modified solar vent flare, a flame arrestor, a fail-close pneumatic isolation valve, a control system, and related appurtenances. The blower is a 3-horsepower Chicago Blower centrifugal vacuum blower designed to supply a vacuum of at least 10.0 inches of water column (in. WC) to the extraction point that is furthest from the blower for each of the systems. Each blower is constructed of spark-resistant construction (e.g., aluminum wheel and housing) and is suitable for handling LFG. A manual butterfly valve located on the inlet pipe to each blower and the variable frequency drive (VFD), which adjusts the blower motor's speed, will be used to adjust the vacuum pressure applied to each LFGCS. The fail-close pneumatic isolation valve on each system is located on the landfill side of the blower and closes whenever the blower shuts off.

An orifice plate flow meter is installed in each blower/flare system, to allow for the manual measurement of the total system flow. Additionally, sample ports are installed for measuring the available vacuum, header vacuum, and the LFG quality. A thermometer is also included near the blower for each system for recording the combined flow temperature.

The blowers convey the collected LFG through a discharge pipe composed of SDR 17 HDPE pipe to the flares. A flame arrestor is installed at the inlet to each of the flares to isolate the blower from the flare in the event of a flashback into the pipe. Windshields are installed at each flare location, which will aid in maintaining combustion in low flow and windy conditions. The blowers and flares of both systems are installed outdoors on concrete pads and the blower/flare components are located within a 6-foot high security fence. The fence should remain closed and locked at all times when the system is unattended.

A control system is installed at each blower/flare system to monitor the flare temperature and to turn the blowers on and off. These controls shut the blower down when no flame is detected and restart the blower after a preset amount of time. The pneumatic fail-close valve opens when the blower starts and fail-closes when the blower is shut down. A timer is installed to allow each blower/flare system to cycle on and off at preset intervals or to be set for continuous operation. This allows for flexibility in the system operation, in case the methane quality decreases during operation. Hours, cycles, and temperature are recorded for each blower/flare system. Faults and flare temperature is displayed on a user interface in the control panel door.

2.2.5 Initial Startup Procedures

Before initiating operation of the flare systems, operation personnel should familiarize themselves with the blower, flare, and system component manuals provided in Appendix A. Furthermore, a competent technician or engineer familiar with the blower and flare operation must be present at the initial startup and operation of the blower/flare system. Thereafter, only authorized personnel are allowed to work on or around the flare and to perform the checks (mechanical, electrical, and equipment).

The blower/flare system can be operated in an automated ("auto" panel switch position) or manual ("hand" panel switch position) mode. The normal operating conditions will be in the automated mode, which includes an automated startup, should the blower flare shut down.

The flare is ignited in both the automated and manual mode utilizing a solar spark igniter. The "on-off" flare igniter switch should be placed in the "on" position to initiate sparking prior to starting the blower. Electrical power for the igniter is provided by a 12V battery attached to the flare assembly, which is constantly charged by the solar panel. The solar panel should be positioned so that it faces southeast. A high-voltage sparking current is created by an igniter rod that resembles a spark plug. A thermocouple located in the flare measures the combustion temperature. The combustion temperature is displayed on the control panel's user interface.

The blower/flare system will run continuously in the automated mode under normal operations. The blower/flare system will automatically shut down if the flare temperature drops below a preset level.

The vacuum applied to the wellfield should initially be controlled by the user-interface controlled VFD installed on each blower. The applied wellfield vacuum can be further controlled by adjusting the inlet butterfly valve. The wellfield vacuum should be set at a level that applies a sufficient vacuum (initially set to -5 to -10 inches water column (in. WC)) at the LFG extraction well that is furthest from the blower.

Further details regarding the operation of the blower and flare are included in Appendix A.

2.3 Leachate Collection System

2.3.1 Air Compressor and Dehydrator System

The lockable storage building on the south side of the site contains an air compressor that provides the compressed air to operate the leachate pumps and operate the fail-close valves on the LFG header pipes in the blower/flare stations. Perform the following checks and adjustments prior to starting the compressor. Refer to the air compressor Operations and Maintenance Manual (Appendix B) for exact instructions for performing these tasks.

Before Operation

1. Confirm the compressor is filled with lubricant according to the manufacturer's recommendations. Fill as needed.
2. Check for oil leaks.
3. Make sure the compressor is turning in the correct direction.

Start-up

1. Switch the "Hand-Off-Float" switch on the compressor control panel in the building to the "Float" position. **Never operate the compressor in the "hand" panel switch mode unattended (in the "hand" position, the high water float in the leachate tank would not turn off the compressor).**
2. Close the service valves in the vault south of the building. **CONFIRM**
3. Release remaining tank pressure by slowly opening the manual drain valve.
4. Close the manual drain valve and apply power to the compressor. If the pressure switch is equipped with an "ON/AUTO-OFF" lever, flip the switch to the "ON/AUTO" position. If the unit is equipped with a control panel "ON/OFF" switch, move the switch to the "ON" position. **CONFIRM**
5. Slowly open the service valve.
6. Read and perform any other checks required by the compressor manufacturer's Operations and Maintenance Manual in Appendix B.

In order to ensure that only clean, dry air is sent to the leachate and condensate pumps, a desiccant-type air dryer has been installed next to the air compressor. Additionally, an oil-coalescing filter is installed between the compressor and the dryer and a particulate

filter is installed on the outlet side of the air dryer. Refer to the dryer Operations and Maintenance Manual (Appendix B) for detailed instructions on the maintenance and operation of the air compressor and desiccant air dryer.

2.3.2 Leachate Extraction Wells

A total of three leachate extraction wells (one dual LFG/leachate extraction well EWL-2 and two leachate extraction only wells at SP-1 and MH-2) will be utilized to remove leachate and condensate from the landfill. Condensate from the three site-wide driplegs gravity drains to each leachate extraction well. The leachate extraction wells include a pneumatic pump that cycles on and off automatically based on liquid levels within the extraction well. The pumps within the wells are powered by compressed air through a 1-inch- diameter (2-inch-diamter at certain locations) SDR 11 HDPE pipe. Refer to record construction documentation drawings for the compressed air pipe locations. Additional HDPE leachate forcemain and HDPE compressed air pipes are installed for the potential future addition of leachate pumps in certain LFG extraction points, should the need arise. An air line control valve is located at each extraction well to shut off the supply of compressed air in the event that pump maintenance or replacement is required. Regulators are located at each extraction point for adjusting the air pressure to the pump. Additional filters are installed at each location to remove particulates and moisture in the event the dryer or upstream filters fail. Isolation valves are installed at strategic location on the leachate forcemain. The leachate collection pumps should be operated and maintained in accordance with the manufacturer's recommendations (see Appendix B).

2.3.3 Leachate Forcemain

The 2-inch–diameter SDR11 HDPE leachate forcemain is relatively free of specific requirements that need to occur for normal use. The leachate forcemain will primarily be monitored by observation of liquid pumping from the extraction wells and collection rates within the collection tank. If the liquid volume removed from the extraction wells is not consistent with the collection volumes within the tank, pressure testing of the forcemain may be necessary to investigate for a possible leak in the forcemain. If back pressure appears to be developing during normal liquid extraction, it may be a sign of sedimentation within the forcemain. In this case, flushing the lines with water may be required. Isolation valves are installed at strategic locations on both the leachate forcemain and the compressed air lines. In the event the leachate extraction system becomes damaged, portions of the lines may be isolated for repair by closing the required isolation valves.

2.3.4 Leachate Tank

Components of the leachate tank are to be operated in accordance with manufacturer's recommended procedures (i.e., tank, valves, pump, etc.) included in Appendix B.

Normal leachate load-out operations will involve a vacuum tanker truck. The number of tanker trucks required for disposal of leachate off-site will be determined by the quantity of leachate collected. At a minimum, the number of tanker trucks provided will be sufficient to keep the collection tank from completely filling. In the event leachate is collected in quantities that cannot be handled through routine tanker truck hauling, an alternative operating plan will be implemented as discussed in Subsection 6.2.

2.4 Landfill Cover

The landfill cover requires specific observation to confirm erosion is controlled. The landfill cover, maintenance road, and surface water drainage features may need regular maintenance. Inspection and maintenance of the cover system are discussed in Section 4.

Section 3
System Monitoring and Process Control

3.1 Landfill Gas Collection System

Monitoring is required to evaluate the LFGCS operation and performance. Routine monitoring of operating parameters is also necessary to facilitate the effectiveness and continued safe operation of the LFGCS. Operation of the LFGCS consists mainly of regulating and adjusting the amount of vacuum applied to each LFG extraction well through the use of valves. This adjustment of vacuum, and therefore flow rate, is referred to as "balancing" the LFGCS system. A balanced system is one in which each LFG extraction well is adjusted to extract the maximum amount of LFG possible while controlling migration and without causing excess amounts of air to be drawn into the landfill.

Monitoring will be performed only by trained personnel who have the proper equipment. The equipment referenced in subsequent sections of this text is recommended for proper system monitoring. Equipment will be internally calibrated according to manufacturers' instructions prior to use. Monitoring is to be conducted in accordance with the LFG monitoring plan discussed in Section 9. Forms for monitoring performance of the system are included in Appendix C.

3.1.1 LFG Extraction Well Monitoring

All of the gas collected by the system is extracted from the LFG extraction wells. Therefore, the monitoring and adjustment of individual LFG extraction wells is the most important aspect of operating the LFGCS. The other system components operate and are adjusted in order to most effectively utilize the wells. For example, the intake vacuum on each blower is set such that enough vacuum is delivered to the LFG extraction wells to establish the most effective radius of influence. LFG extraction wells will be monitored for CH_4, CO_2, balance gas (N), O_2, temperature, pressure (vacuum), flow (differential pressure), and valve setting.

Control Valve Setting

To monitor the individual wells, perform the following steps:

1. Visually inspect the LFG extraction wells for loose bolts, hose clamps, pipe, and connections, etc.

2. Note and record the valve setting by the number of visual ticks or turns (from the closed position).

Measuring Pressure (Vacuum)

1. Attach a hose to the monitoring port on the header side of the valve, and connect it to the negative pressure hose barb of the magnehelic pressure gauge. Open the monitoring port (if labcock style), and record the LFG header's applied vacuum. Insect nesting or ice may block monitoring port openings. If header pressure monitoring is necessary for troubleshooting purposes, and the monitoring port is blocked, unscrew the threaded sample port from the pipe and clear the blockage with an appropriate tool, if necessary. Visually inspect the sample port to determine if it is free from blockage, and reattach it. If not free, monitor the header pipe directly by inserting the hose directly into the pipe and plugging the annular space around the hose with a rubber stopper or other suitable temporary seal. The seal must be airtight to get an accurate reading. Reattach the threaded sample port.
2. Repeat the above procedure with the monitoring port on the well side of the valve. If this sample port is blocked, remove the threaded plug of the monitoring port and monitor the pressure using a rubber stopper fitted with a hose barb. Make sure that the blockage has been cleared.

Measuring Flow Rate (Differential Pressure)

1. Attach a hose from the high pressure port onto the orifice plate to the high pressure (positive) port of the magnehelic pressure gauge and connect the low pressure port onto the low pressure (negative) port of the magnehelic pressure gauge. Open the monitoring ports (if labcock style) and record the differential pressure. Compare the pressure to the flow graph located in the wellhead section of Appendix A to determine the flow rate. Insect nesting may block monitoring port openings. If the monitoring port is blocked, unscrew the threaded sample port from the pipe and clear the blockage with an appropriate tool. Visually inspect the sample port to determine if it is free from blockage, and reattach it. If not free, monitor the header pipe directly by inserting the hose directly into the pipe and plugging the annular space around the hose with a rubber stopper or other suitable temporary seal. The seal must be airtight to get an accurate reading. Reattach the threaded sample port.

Measuring Oxygen, Carbon Dioxide, Balance Gas (Nitrogen), and Methane

1. Calibrate the LFG monitoring instrument according to the manufacturer's recommendations.
2. Monitor the CH_4, O_2, and CO_2 content using the gas monitoring instrument in conjunction with the sample port on the well side of each wellhead.
3. Balance gas is the remaining percentage of gas after the percentages of CH_4, CO_2, and O_2 are added together.

$$\text{Balance Gas (N)} = 100\% - (\%CH_4 + \%CO_2 + \%O_2)$$

4. Record the gas content.

Measuring Temperature

1. Insert the temperature probe into the monitoring port or dually read the temperature from the wellhead thermometer, if so equipped.
2. Record the stabilized temperature in degrees Fahrenheit.

Miscellaneous

1. Visually inspect each wellhead to determine that all sample ports are closed and that all open pipes are sealed against air intrusion.
2. Visually inspect each wellhead to determine that all are in good condition and free of surface water.

3.1.2 System Monitoring

The capability to monitor the system as a whole is provided at the two blower/flare stations. The pressure (positive and negative); the CH_4, O_2, CO_2, and balance gas (N) content; the temperature; and the outlet gas flow rate will be monitored. Automated system monitoring equipment is included within the system to prevent potential equipment damage or a release of LFG to the atmosphere. Automated monitoring includes the flame detection thermocouple with a flare, and a high-temperature (initially 1,800°F) and a low-temperature (initially 500°F) alarm. In the event that a flame is not detected or the high- or low-temperature alarm condition is reached, the system will shut itself down and the controls of the flare will attempt an automated restart of the system. If the restart sequence does not correct the alarm condition after three restart attempts, the flare will shut down for a preset number of hours and then attempt another restart sequence. If the flare still does not light after three attempts, the flare will stay down for a longer preset number of hours before attempting another restart. To address the flare shutting down and not restarting properly, a O,M&M staff member

will be notified by District personnel and will respond by visiting the site to troubleshoot the shutdown and failure to restart. Temperature is monitored automatically and recorded in a programmable logic controller (PLC) within the blower/flare control panel. The following steps outline the procedures for monitoring each of these parameters:

Measuring Pressure

1. Take pressure measurements prior to LFG sampling being careful not to introduce atmospheric air into the monitoring port. Connect the hose on the low side of a magnehelic pressure gauge to the monitoring port prior to opening the valve. Open the valve, and record the pressure. Close the valve.
2. Perform the above procedure on both the positive pressure and vacuum sides of the blower.

Measuring Methane, Carbon Dioxide, Balance Gas (Nitrogen), and Oxygen Contents

1. Equipment used for monitoring LFG concentrations should be turned on and calibrated according to the manufacturer's recommendations prior to taking system gas readings in order to obtain stable readings on ambient gas concentrations. After ambient gas levels have stabilized, attach the inlet hose of the gas monitoring instrument to the monitoring port, prior to opening the valve. Open the valve to draw a gas sample. Allow the readings to stabilize (typically about 60 seconds), and record the values.
2. Let the monitoring instrument purge itself with air (disconnect inlet tubing and allow pump to run) such that it reads zero or is representative of the atmospheric air prior to proceeding with sampling.
3. Balance gas is the remaining percentage of gas after the percentages of CH_4, CO_2, and O_2 are added together.

$$\text{Balance Gas} = 100\% - (\%CH_4 + \%CO_2 + \%O_2)$$

If the O_2 content of the extracted LFG is greater than or equal to 4 percent, or if the methane content is less than 40 percent, monitor each of the wells to identify and reduce the oxygen concentration or increase the methane concentration.

Measuring Flow Rate

- The flow rate is measured with the orifice plate mounted directly in the LFG pipe. The flow rate is obtained with a magnehelic gauge, connecting hoses from the gauge to sample ports on both sides of the orifice plate. The differential pressure obtained from this measurement can be referenced to a flow versus differential pressure graph located in the blower section of Appendix A for determining flow.
- An alternative method is to measure flow rate by the pitot tube method. Follow manufacturer's recommended procedures for use of the pitot tube to determine flow rates.

Measuring Flare Temperature

The LFG flare will normally be operated at temperatures ranging from 500°F to 1,800°F. Operation of the flare above 1,800°F could potentially damage the flare. The flare temperature is monitored continuously with a thermocouple mounted in the flare. To maintain the efficiency of the flare, the flare will be automatically shut down if the temperature exceeds 1,800°F or falls below 500°F. In the event of a flare shutdown due to high temperature or low temperature, the blower will shut down and the actuated valve located upstream of the blower will automatically close. The system is programmed to attempt a restart after a predetermined length of time following a shutdown.

A display of both the set point temperature and the actual combustion temperature is provided on the flare control panel. Record the actual combustion temperature on the monitoring form located in Appendix C.

3.1.3 Landfill Gas Process Control

LFG is typically generated at a mixture of approximately 50 percent methane and 50 percent carbon dioxide. A high methane concentration usually indicates that more gas is being generated than is being extracted by the well. A low methane concentration is the primary test for determining if the applied vacuum should be changed. In order to operate the LFGCS effectively, the system must be balanced. Balancing is the process of adjusting the vacuum applied to each LFG extraction well in order to extract the LFG stored within the landfill initially and then to extract the LFG at its rate of generation.

Because methane production in the landfill is dependent upon many factors, the amount of vacuum required to extract the gas will vary at each well and also with time. Generally, less vacuum is applied to the LFG extraction wells along the system's

perimeter. Experience has shown that this will usually be adequate to control LFG migration and that greater vacuums usually result in excessive air intrusion.

Whenever any part of the LFGCS is shut down for more than a few days, the entire system may require balancing. Changes in one part of the system will likely affect the entire system. Careful monitoring is extremely important in operating a dynamic LFGCS. The goals of system balancing are as follows:

- To control LFG migration
- To adjust the vacuum to maximize the methane concentration and minimize the oxygen content
- To maintain extraction well methane levels well over the upper explosive limit (UEL) of 15 percent by volume
- To maintain the extraction rate at or near the production rate to prevent oxygen infiltration into the landfill

In order to balance the system, the following steps will be taken:

1. Monitor the gas pipe at each blower station, for pressure, CH_4, CO_2, balance gas (N), and O_2.
2. Compare the measured pressure with the previously recorded stabilized steady-state pressure, and adjust the VFD (or the main control butterfly valve) at the blower accordingly (increase or decrease). The objective is to adjust the pressure (vacuum) so that pressure readings are approximately the same as those previously recorded.
3. Adjust each LFG extraction well to its previously stabilized pressure (if known), beginning at the well closest to the blower and proceeding around the loop.
4. If small adjustments in a wellhead valve cause very large swings in the applied well pressure, readjust the VFD (or butterfly valve) at the blower to a less negative pressure. Incrementally reduce the blower speed or close the butterfly valve until the wellhead gate valve can better adjust the applied LFG extraction well pressure.
5. Adjust each LFG extraction well of the branch to its previously stabilized pressure. Then, proceed back toward the blower station, readjusting each LFG extraction well. In this way, each LFG extraction well will be adjusted twice, except the LFG extraction well at the end of the loop.
6. Adjust LFG extraction wells individually as indicated in Table 1.

3.1.4 Perimeter Gas Probe Monitoring

The gas probes monitor for the migration of LFG beyond the landfill footprint. As part of the system performance evaluation, the perimeter probes must be monitored for CH_4, CO_2, balance gas (N), and O_2, and pressure. The LFGCS monitoring plan is discussed in Section 9. The following steps will be performed at each perimeter probe:

Measuring Pressure

1. Measure pressure prior to gas sampling, taking care not to introduce atmospheric air into the monitoring port.
2. Connect the hose on the low side of a magnehelic pressure gauge to the monitoring port prior to opening the valve.
3. Open the valve, and record the pressure. If it is necessary to switch the hose to the high pressure side, close the valve first.
4. Close the monitoring valve.

Measuring Methane, Carbon Dioxide, and Oxygen Contents

1. Monitor the methane, carbon dioxide, oxygen, and balance gas content using the gas monitoring instrument in conjunction with the sample port.
2. Follow the procedure described in Subsection 3.1.2 (System Monitoring) for using the instrument, and record the gas constituents.

3.2 Leachate Collection System Monitoring

Monitoring the performance of the LCS requires gathering the information necessary to determine whether the pumps are running, if liquids are being removed, and whether or not the LFG extraction well screen is blinded (EWL-2 only). In addition, the leachate collection tank has a high liquid level shut-off float and a manual level indicator on the tank itself indicating when the collection tank requires emptying.

3.2.1 Leachate Head Levels

Liquid levels within the leachate and LFG extraction wells will be monitored throughout the operational period. Liquid level measurements in the extraction wells will be performed by direct measurement with a liquid level indicator. The equipment manufacturer's recommendations are to be followed for all monitoring.

3.2.2 Flow Measurement

Liquid flow measurement from each well will be conducted by recording the cycle counter reading on the pump controller and recording the flow totalizer on the dial flowmeter. Each cycle represents a known quantity of liquid (approx. 0.25 gal) based on the type of pump utilized. Further information on the cycle counter is included in Appendix B.

3.2.3 Tank Level

The liquid level within the leachate storage tank can be determined by an external level indicator on the front of the tank (north side). Additionally, a high-level float is installed on the top of the tank. When the high-level alarm is activated the compressor is automatically shut down so no compressed air is sent to the pumps. **The compressor control in the buildings must be set to "float" to allow for high leachate levels in the tank to shut down the compressor (and pumps).** The high-high level float is set at a level that will prevent tank over-flows, even if the pumps cycle for a period of time following the compressor shutdown. The frequency of leachate removal from the site may initially be performed on a set schedule (e.g., 3 times per week) depending on the quantities of leachate collected. The leachate hauling frequency will be adjusted seasonally and over time based on the volume pumped.

To the extent practical, leachate levels in the storage tank will be maintained to provide for continuous operation of the leachate collection system. Removal of leachate from the storage tank by tanker truck will be performed to prevent shutdown of the system for no more than a brief period.

Section 4
System Equipment and Maintenance

4.1 General

A well-operated LFGCS and LCS depends, to a large extent, on the implementation of a good preventive maintenance program. Preventive maintenance is important to the long life of the LFGCS and LCS equipment and is often necessary to qualify for manufacturers' warranty protection. Because the management systems are typically expected to be operational 24 hours a day, every day of the year, it is vital that a regular preventive maintenance program be incorporated in the routine work schedule at the landfill.

The tasks outlined in this chapter serve as a minimum recommended list of maintenance tasks from which a detailed checklist may be developed. All equipment manufacturers' maintenance requirements, as listed in their operation and maintenance manuals, must be incorporated into the work schedule. **NO MAINTENANCE TASK IS TO BE PERFORMED WITHOUT FIRST CONSULTING THIS MANUAL, AND THE RESPECTIVE EQUIPMENT MANUFACTURER'S OPERATION AND MAINTENANCE MANUAL.**

Before any maintenance is performed, safety precautions, such as shutting off and locking-out power supplies, must be followed (refer to Section 7). Maintenance activities will be documented in O,M&M reports (see Section 8).

4.2 Landfill Gas Collection System

4.2.1 Landfill Gas Extraction Wells

Periodic maintenance will be required of the system to keep it running smoothly and efficiently. Because LFG extraction systems are dependent on the integrity of the landfill cover, maintaining the landfill cover becomes part of maintaining the gas extraction system. Additionally, because refuse in the landfill is continually decomposing, problems due to differential settlement will be an ongoing maintenance item.

The following maintenance tasks are to be performed at each well monthly or as needed:

1. Remove weeds and debris from around LFG extraction wells.
2. Inspect hose clamps for tightness.

3. Inspect LFG extraction well assemblies for loose bolts, cracks in pipes, air or water leaks in pipes, broken valve handles, evidence of differential settlement (such as stretching of the flex hose), or other evidence of integrity failure.
4. Confirm that any vaults (EWL-2) are closed at all times when unattended.
5. Inspect the integrity of the well vaults.

4.2.2 Landfill Gas Header and Lateral Piping Network

Monitoring of vacuum, CH_4 and O_2 concentration, temperature, and flow rate at the wells will identify problems in the piping system. Two problems that may be encountered are surging and pipe breaks. Surging is a cycle of restricted and unrestricted LFG flow caused by condensate trapped in low points of the header.

1. Normal maintenance of the piping consists only of operating the valves quarterly.
2. If normal monitoring and operation of the system indicates the presence of surging or a pipe break, the following procedure should be followed:
    - Close all wellhead valves on the isolated portion of the header.
    - Excavate the pipe in the area where the settlement or break is most likely to have occurred. Repair the damaged pipe.
    - Replace and recompact cover material over the pipe.
    - Open wellhead valves.

4.2.3 Condensate Driplegs

The following maintenance tasks are to be performed quarterly.

1. Remove weeds and debris from around the driplegs.
2. Check to see that the pumps are functioning properly.
    - The drip legs drain the three existing leachate extraction points, so maintaining the leachate collection system is critical to the dripleg's function.
3. Verify sufficient liquid is in each dripleg using a liquid level indicator or by checking for a vacuum in the dripleg. If the liquid level drops below the gas header pipe, the vacuum in the header system has the potential to pull in ambient air and disrupt the balance of the system. Water should be added on an as needed basis.
4. Confirm that all leachate extraction well vaults are closed at all times when unattended.

4.2.4 Blower and Ancillary Equipment

Monthly

Refer to manufacturer's manual (Appendix A) for detailed procedures.

1. Check for leaks in piping and valve connections.
2. Check for vibrations and loose connections.

Quarterly

1. Lubricate blower bearings according to manufacturer's recommendations. Use only a grease recommended by the blower manufacturer.

   WARNING: DO NOT OVER-GREASE OR PERMIT CONTAMINANTS TO ENTER THE GREASE CHAMBER. DO NOT USE STANDARD CUP GREASE.

2. Lubricate motor bearings quarterly according to manufacturer's recommendations. Use only lubricants specified (type and quantity) by the manufacturer.

   WARNING: DO NOT OVER-GREASE. MOTOR WINDINGS MAY BE PERMANENTLY DAMAGED.

3. Clean grease inlet area of the motor to prevent grease contamination. Lubricate only with manufacturer's recommended grease that is fresh, and free from contamination.
4. Check the operation of the pneumatic fail-close valve.

Every 6 Months

1. Check motor/blower alignment.

Annually

1. Clean and repack grease reservoir in each blower following manufacturer's instructions.
2. Check/Tighten electrical connections on motor control panel and at motor.

4.2.5 Flare System

Maintenance requirements for the flare system are summarized below. Refer to the manufacturer's instructions (Appendix A) for detailed maintenance procedures.

1. Each month, inspect the igniter for proper operation and check the electrical connections.
2. Each month, check the operation of the solar blower (UAV-4 flare location only).
3. Quarterly, remove weeds and any debris from around the flare.
4. Semiannually, check the igniter for carbon build-up. Clean if necessary.
5. Each year, inspect and clean the flame arrestor.
6. Each year inspect the thermocouple for deterioration and replace if necessary.
7. As needed, clean the solar panel.
8. Refer to the Flare Manual (Appendix A) for maintenance procedures for each flare system component.

4.2.6 Winterization

The following tasks are to be completed for the LFGCS yearly, prior to the initiation of cold weather.

1. Install heat tracing on the above grade LFG piping near the blower/flare system, if necessary.
2. Power heat tracing (if installed) during cold periods.
3. Check blower/flare heat tracing and insulation for deterioration and replace if necessary.

4.3 Leachate Collection System

4.3.1 Compressor and Air Dryer System

Refer to the equipment manufacturer's Operations and Maintenance Manuals (Appendix A) for detailed instructions on how to perform all of the maintenance tasks.

4.3.2 Leachate Extraction Pumps

All pneumatic pumps should be maintained according to the manufacturer's recommendations. In addition, all pumps should be pulled routinely from the well for visual inspection and cleaning. Worn parts are to be replaced as needed. Connecting

hoses and valves should be checked for wear or damage and replaced as needed. Flow meters and cycle counters should be checked monthly for proper operation.

4.3.3 Leachate Collection Tank and Loadout Facility

The leachate loadout facility will require periodic mowing to keep vegetative growth in control. The hi level shutdown float in the leachate collection tank should be activated on a quarterly basis to verify proper operation.

4.3.4 Winterization

The following tasks are to be completed for the leachate collection system yearly, prior to the commencement of cold weather.

1. Blow out compressed air lines to remove any accumulated water.
2. Pump the leachate tank more frequently to prevent freezing.
3. Turn on leachate tank heat tracing. Inspect the heat tracing and pipe insulation for evidence of deterioration, replace if necessary.
4. Turn on the leachate circulation pump. Maintain the leachate circulation pump according to the manufacturer's recommendations. Refer to the pump manual in Appendix B.

4.4 Cover Maintenance

Maintenance of the cover system involves inspecting and repairing potential settlement areas, those areas bare of vegetation, and those areas affected by erosion.

4.4.1 Mowing

Vegetation will be mowed and trimmed as necessary, but no less frequent than annually to control volunteer deep-rooted weeds and grasses. Care will be taken not to over cut or otherwise damage grass/vegetation during mowing activities.

4.4.2 Settlement

Differential settlement may occur over time as the result of waste decomposition and liquid extraction. Settlement is not expected to be a significant problem since the waste has been in-place and subject to decomposition for at least 30 years. Repairs will be made if settlement results in ponding surface water on top of the cover system in an area of more than approximately 100 square feet. Existing topsoil in the affected area will be stripped and stockpiled adjacent to the area. General soil will be used to fill the settled area to restore uniform grades and promote drainage. Topsoil will be replaced,

reseeded, and mulched. Areas of repairs greater than 1 acre will be documented with a letter report and a drawing. The report will provide a narrative description of the settlement problem and the repair activities. The drawing will show the location of the final cover surface area repaired and the revised grading for the area.

4.4.3 Erosion and Sediment Control

Although the final cover was designed to minimize erosion, minor erosion may occur in isolated areas. Cover repairs will be made whenever evidence of erosion is noted. If the erosion is minor, then maintenance will entail filling erosion marks with topsoil and seeding. If the erosion is more extensive, then the affected area will be graded to fill erosion marks and additional topsoil will be placed to final-dress the area, followed by reseeding. Additional measures may include temporary run-on diversion around the repaired area by the use of silt fences or hay bales.

4.4.4 Revegetation

Weather and site conditions will require periodic maintenance to sustain healthy vegetation. Reseeding may be necessary in bare areas developed due to weather or other construction activities. Revegetation will be performed as soon as practicable with consideration of the local growing season and weather conditions.

If reseeding is required due to the disturbance of the cover soil, then the initial construction specifications will apply. The seeding rate and species may require modification due to availability or site experience with initial species.

4.4.5 Fencing and Signs

Repairs or replacement will be made as necessary in response to site inspections. Possible problems could include deterioration, erosion, or frost heave of fence post anchors resulting in fence damage. Normal wear, deterioration, and vandalism are also possible on fencing, gates, and locks. Signs will be replaced if they are not legible.

4.5 Maintenance Schedule Summary

Table 2 summarizes the major maintenance tasks outlined in this subsection. The information in the table is not a comprehensive list of maintenance responsibilities, but is intended to serve as a minimum guide in establishing a routine maintenance schedule. Maintenance personnel should develop a more detailed maintenance schedule based on the information in this manual, the equipment manufacturers' manuals, and experience with the site systems.

Section 5
Potential Operation Problems

5.1 Landfill Gas Collection System

Proper operation of the LFGCS requires appropriate response to the monitoring data. At times, the LFGCS will react to a situation that was not previously recognized. The operator must determine the cause of the reaction and decide how to remedy the problem.

Important tools in troubleshooting are the monitoring instruments. After checking operation and calibration, all of the symptoms will be rechecked to make sure that a number was not misread or that the problem has not corrected itself. The following items will be checked first before spending additional time with diagnosis:

- Check equipment integrity.
- Check monitoring data.
- Follow the troubleshooting guides in the following subsections.

5.1.1 Landfill Gas Extraction Well System Adjustments

After verification of the monitoring equipment integrity and confirmation of the monitoring data at the LFG extraction wells, follow the adjustment recommendations contained in Table 1 (see Section 3).

5.1.2 Landfill Gas Collection System

For problems with the LFGCS, refer to the troubleshooting checklist in Table 3.

5.1.3 Blower Station

For a summary of blower troubleshooting, refer to Table 4.

5.1.4 Flare Station

For a summary of flare station troubleshooting, refer to Table 5.

5.2 Leachate Collection System

Proper operation of the leachate management system requires appropriate response to the monitoring data and site observations. Actions to be taken when particular conditions are present in the system are summarized in Table 6.

During periods of cold weather, there is the potential for freezing of collected leachate in the transfer line prior to discharge to the forcemain. This potential has been minimized by placing the forcemain connection in an underground vault. To further prevent freezing of collected leachate, the circulation pump on the leachate storage tank should be started prior to the initiation of cold weather and run through the entire period. In the event the lines start to freeze, the operation of the pneumatic pumps should be changed to keep a slow, steady flow through the collection lines, or as recommended by the manufacturer.

5.3 Landfill Cover System

Because the landfill cover is functional as placed, no operational problems are expected. Inspection and maintenance of the cover system are discussed in Section 4.

5.4 Groundwater Monitoring Wells

Groundwater monitoring wells are not expected to pose operating problems. Groundwater monitoring methods and equipment are discussed in detail in the Groundwater Monitoring Plan.

Section 6
Alternative Operations and Maintenance

6.1 Landfill Gas Collection System

Alternative operations and maintenance of the LFGCS is not expected. The selected components of each LFGCS are designed to function for various LFG flow rates (2 to 75 cfm for each system) in combination with the LCS and final cover. In the event that a single component of the LFGCS system becomes nonoperational, temporary replacement equipment can be brought onto the site. For example, a replacement blower may be required.

In the event that methane collection rates or concentrations drop below the levels needed to operate the flare, attempts to balance the system as described in Subsection 3.1.3 should be made. If the methane collection rates or concentrations continue to be below those required for flare operation, the flare can be operated on a timed basis. In the event that the gas collection rates are greater than the flare capacity, the flare can be modified to increase capacity or a second flare unit can be brought on-site.

6.2 Leachate Collection System

Alternative operation of the LCS may be necessary in the event the volume of leachate removed from the leachate extraction wells is greater than the quantity that can be managed via the storage tank and off-site shipments of leachate, two alternative methods of operating the system are available as follows:

- **Alternative 1:** Supply additional aboveground leachate storage capacity. Additional aboveground storage tanks can be located near the existing aboveground storage tank. The additional quantity of storage capacity required will depend upon the availability of trucks to haul leachate off-site for disposal and treatment. Additional storage capacity will only serve as a temporary means of operation until collected leachate volumes can be managed adequately by trucks used for hauling.
- **Alternative 2:** Reduce leachate collection rates from extraction wells. Reducing collection rates of liquid can be accomplished by adjusting the regulator for the pneumatic pumps. This method of operation should be used only temporarily until arrangements can be made for more leachate hauling trucks.

In the event a single component of the LCS becomes nonoperational, replacement equipment can be utilized. For example, if the compressor goes down, a temporary compressor can be

utilized to keep the system operational or if a pneumatic pump stops operating, a replacement pump can be installed.

6.3 Landfill Cover

There are no alternative operational methods for the landfill cover.

Section 7
Safety Plan

7.1 General

Personnel operating and maintaining the system should be thoroughly familiar with safety practices. Personnel are to be aware that the information in this manual is not intended to be comprehensive. All maintenance and inspection activities will be governed by the Site Health and Safety Plan. The safety precautions stated here are not to be considered the only precautions necessary, and are no substitute for an alert, informed, and responsible person. Individuals and contractors working on the site need to be familiar with their own site-specific Health and Safety Plan.

7.2 Landfill Hazards

In addition to general safety hazards that may be present in any work situation, hazards specific to landfill sites may also be present. Employees may expect to encounter, at a minimum, the following hazards when operating and maintaining the LFGCS:

- Fires and explosions may occur from the presence of methane gas.
- LFG may cause an oxygen-deficient atmosphere in underground vaults, trenches, structures, and conduits.
- Hydrogen sulfide, a highly toxic and flammable gas, may be present.
- Fires may start spontaneously from exposed and/or decomposing refuse.
- Lateral gas migration to adjacent areas in addition to venting to the atmosphere through the cover soil may occur.
- Direct contact with LFG condensate and leachate should be avoided.

7.3 Fire and Explosion Safety

Landfill personnel must be trained in the use of fire extinguishers and must be familiar with their location on-site. A fire extinguisher will be located in the air compressor building, as well as in the landfill personnel's vehicle. In the event of a major fire, all personnel must leave the area of the fire and notify the Fire Department. Do not attempt to use a fire extinguisher on a major landfill gas fire.

If an explosion occurs, further explosions must be prevented by isolating the source of ignition, if possible. Keep people a safe distance from the site of the explosion. For both fires and

explosions, the gates to the facility or to the blower/flare area must be kept closed to all but emergency vehicles.

7.4 Electrical Safety

Lock-out and tag main switch of electrical equipment before working on it.

- Do not remove the tag without first checking with the person who initiated the tag.
- Notify supervisor in the event a motor circuit breaker trips out.
- Do not open motor control panels unless you are trained and authorized to perform the work.
- Report and log any unusual motor noise or vibration.

7.5 Confined Space Safety

Poor ventilation within certain structures in the LFGCS may result in one or more of the following hazards: toxic gas accumulation, flammable or explosive atmosphere, or oxygen deficiency. These structures include the following:

- Well vaults
- Leachate collection tank

Depending on the situation, these structures may be defined as either confined spaces or permit-required confined spaces, and each requires that special safety precautions be taken.

7.6 Site Safety Rules

All employees shall observe and obey every rule, regulation, and order necessary for the safe conduct of the work, and shall take such action as is necessary to obtain compliance. Employees shall report all unsafe conditions or practices to the appropriate person or agency.

7.7 First Aid

Employees should be familiar with basic first aid procedures, including:

- Prompt attention to injuries is important.
- Call a physician for all but minor injuries. Contact the Fire Department immediately in cases where resuscitation is needed and when landfill gas mishaps occur.
- If there is a possibility of coming into contact with condensate formed on the inside of the piping system or leachate, wear rubber gloves. This will prevent exposure to potentially hazardous compounds, especially if the hands are chapped or burned, or if the skin is broken in any other manner.

- Keep fingers away from the nose, mouth, and eyes to prevent exposure.
- Wash hands thoroughly after work and before eating. The use of antiseptic solutions will help prevent infection.
- Keep the nails short and remove foreign material with a nail file or stiff soapy brush.
- Keep in mind that, when the hands are soiled, smoking pipes or contaminated ends of cigarettes or cigars may introduce potentially hazardous compounds into the body.
- Do not smoke near any areas of the LFGCS.

Section 8
Reporting

8.1 General

This section describes the content of the quarterly (may be reduced to semiannual) progress reports that will be submitted during the O,M&M phase. Several other miscellaneous records and reporting mechanisms are also discussed in this section. These items will be attachments to the progress reports.

8.2 Progress Reports During O,M&M

The quarterly O,M&M report will provide a summary of the effectiveness of the system. Data on system operation, operating problems, and monitoring (when applicable) will be supplied. The quarterly reports will provide the formal transmittal of laboratory test data or field measurements to the regulatory agencies. Each report will include a discussion of the effectiveness of the systems in achieving the site objectives and a description of any proposed operational changes if required. The quarterly O,M&M reports will also provide a summary of sampling and analysis activities.

In general, the O,M&M progress reports will contain the following information:

- A summary of operational conditions, maintenance activities performed, and repairs required on the system components, including the following:
  - LFGCS
  - LCS
  - Landfill cover
- A summary of operational changes made since the last report submission
- A summary of operational issues or potential operational issues encountered during the reporting period and actions taken to correct the problems
- Data tables providing quantitative data on the systems
- A summary of the maintenance procedures implemented during the reporting period
- Any required changes to maintenance frequency
- Repairs implemented outside of the scope of normal maintenance
- Summary of performance of the system components

- Summaries of contact with representatives of the local community, public interest groups, or local or state governments
- Changes in personnel
- Projected work for the next reporting period
- Appendices as follows:
  - Monitoring data forms
  - Maintenance records
  - Inspection reports
  - Incident reports
  - Repair reports

8.3 Miscellaneous Reports

During the O,M&M period, miscellaneous reports will be submitted as attachments to the O,M&M reports, as warranted. This section describes the general content of these miscellaneous reports.

8.3.1 Inspection Report

As stated in this O,M&M Plan, inspections will be conducted on the landfill cover and security fence, the LCS and LFGCS, the gas monitoring probes, and the monitoring wells. Inspection forms for these activities (see Appendix C) will constitute the inspection report.

8.3.2 Incident Report

An incident report form will be completed in the event of miscellaneous occurrences on-site that impact site operations. These may include fires, equipment breakages/damages, accidents/injuries, and weather-induced damages. This report will include the following information:

- Date/Time of incident
- Type of occurrence
- Names of personnel reporting
- Names of personnel involved
- Type of equipment involved
- Summary of actions

8.3.3 Maintenance Report

If significant repairs are made to the cover system, monitoring systems, or leachate and gas management systems, a report describing the extent of the repairs will be prepared and attached to the quarterly O,M&M report.

8.4 Reporting Schedule

Quarterly reports will be submitted within 45 days of the end of the reporting period. This will allow for data evaluation. The first O,M&M report submitted will be for the quarterly reporting period following approval of the Construction Documentation Report.

Quarterly O,M&M reports may be replaced by semiannual reports after the initial year of operating the LFGCS.

Section 9
Landfill Gas and Leachate Collection System Routine Monitoring Plan

9.1 Description of Monitoring Tasks

The following subsections describe the specific tasks associated with the LFG and leachate monitoring plan.

9.1.1 Landfill Gas Monitoring

The LFG monitoring program is designed to evaluate the LFGCS operation and performance in preventing the migration of LFG by extracting the maximum amount of LFG from the area surrounding each well while minimizing the amount of air intrusion into the waste. The specific list of monitoring parameters, the frequency of monitoring, and the locations of monitoring points are detailed in Table 7 and the locations are shown on Figure 1.

9.1.2 Leachate Monitoring

The leachate monitoring program is designed to evaluate the effectiveness of the LCS. Specifically, the program is designed to evaluate leachate levels at certain locations within the landfill.

The monitoring parameters pertaining to the leachate level measurements, the monitoring frequency, and the monitoring locations are detailed in Table 7 and the locations are shown on Figure 1.

Leachate level monitoring is designed to determine the effectiveness of the LCS in reducing leachate seeps in the landfill. Monitoring of the liquid levels will be performed at the two leachate extraction wells (MH-2 and SP1) and the one dual extraction well (EWL-2), as well as the LFG extraction wells listed in Table 7.

9.2 Routine Monitoring Schedule

Sixty (60) landfill gas probes, listed on Table 7, will be monitored monthly for a period of 1 year, at which time the frequency and number of monitoring points may be adjusted. The parameters monitored will be pressure, methane (CH_4), carbon dioxide (CO_2), oxygen (O_2), nitrogen (N, as a balance gas), and liquid levels. The sixteen (16) landfill gas extraction

wellheads, listed on Table 7, will be monitored monthly for 1 year, at which time the frequency may be adjusted. The parameters monitored will be pressure (header and well), CH_4, O_2, CO_2, balance gas (N), flow rate (scfm), temperature, and liquid level. The pressure (pre- and post-blower), CH_4, O_2, CO_2, balance gas (N), flow rate (scfm), temperature at the blower will be monitored on a monthly basis.

Leachate levels, totalizer readings, and cycle counter readings at each of the three (3) leachate extraction wells will be measured monthly for 1 year, at which time the frequency may be adjusted.

Refer to Table 7 for a summary of the monitoring schedule.

9.3 Monitoring Data Assessment Contingent Actions

This section establishes a process for assessing the environmental monitoring data collected at the MNL and the criteria for determining the need to develop contingent actions when compliance with established long-term performance standards is not achieved. These monitoring-triggered contingent actions may result from the following:

- Inadequacies in leachate drawdown at key locations (leachate seeps)
- Inadequacies in LFG quality
- Methane concentrations in perimeter probes suggesting off-site methane gas migration

The O,M&M Plan discusses in detail the contingent actions required for the normal day-to-day findings associated with routine wear and aging of the facility noticed during routine inspections (*e.g.*, leachate seeps, erosion of soil cover, collapsed or clogged pipes/wells, landfill settlement, and adjustments to the active LFG/leachate collection system).

The contingent actions outlined in this section should be reviewed and revised if necessary when any of the following occur:

- A facility event occurs for which this plan did not provide an appropriate contingent action.
- Changes in the design, construction, operation, or maintenance necessitate a change in appropriate corrective actions.
- Goals and objectives for the facility (see Sub-section 1.3) are amended or reissued.

This plan has been developed to meet the goals and objectives listed in Section 1.3 and should not be construed to indicate that failure of any element at the site is anticipated.

As remedial measures are being implemented at this facility in response to existing concerns, monitoring-triggered performance standard exceedences will generally not result in the immediate initiation of contingent actions. Single occurrences of an exceedence may be addressed through continued monitoring and/or further assessment. For example, consistent high methane detections at perimeter gas probes after all possible operational adjustments have been made may be the basis for determining the need for any contingent actions.

If the above evaluations indicate that existing remedial actions are not performing effectively, a contingent action may be necessary and should be evaluated. It is important to understand that any potential problem has a number of possible solutions and that no plan of action can directly address all circumstances encountered. Therefore, the following general plan of action should be considered conceptual and therefore flexible.

9.3.1 Landfill Gas Collection System

Landfill Gas Data Assessment

Monitoring data collected from the LFGCS within the limits of waste and from the perimeter gas probes will be used to evaluate the performance of the system. The results from monitoring the LFGCS will be compared with historical system data. Perimeter gas probe results will be compared with goals and objectives (see Sub-section 1.3), regulatory standards and historical data. If the results of the LFG monitoring indicate that the LFGCS is not achieving goals and objectives (see Sub-section 1.3) within a reasonable period of time, the necessary steps will be taken to correct the performance of the system. Operation and maintenance adjustments to the LFGCS may be adequate to address potential isolated incidents of LFG migration if they are detected.

Determination of Need for Contingent Actions

If off-site methane levels persist after all possible operational adjustments to the LFGCS have been made and the LFGCS has had a period of time to respond to the adjustments, increased monitoring and/or modifications to the LFGCS will be evaluated. Any such modification to the LFG monitoring program or significant modification to the LFGCS will be made following consultation with the District, the IEPA, and the U.S. EPA.

9.3.2 Leachate Collection System

Leachate Collection System Performance Assessment

The primary objective of the LCS is to reduce leachate levels at certain locations to prevent off-site releases of leachate (see Sub-section 1.3). For each monthly monitoring period (may be adjusted after the first year), the following will be reported:

- Volume of leachate pumped from the site
- Leachate level measurements

Determination of Need for Contingent Actions

Modifications to the LCS may be necessary to improve system performance or to address leachate seeps. Criteria such as the following will be used for evaluating the long-term performance of the LCS:

- Is there sufficient leachate storage tank capacity?
- Is the LCS preventing off-site releases of leachate or is there a need for additional leachate extraction wells?

Each of these two criteria is discussed in greater detail in the following sections:

Leachate Storage Tank Capacity

The current leachate storage tank is a 21,000-gallon rectangular aboveground leachate tank (Appendix B contains a drawing). Current load-out of the leachate storage tank occurs approximately every 2-3 days. The leachate storage tank load-out frequency could be increased to eliminate hi-level shutdowns of the LCS.

Prevention of Leachate Seeps

Evaluation of the elimination of leachate seeps throughout the landfill will be conducted by periodic site inspections and review of the leachate elevations and pumping data. If leachate seeps, which pose a risk of an off-site release, appear in an area of the landfill, an evaluation will be made as to whether other action (*e.g.*, increased pumping rates, well cleanout, additional extraction wells, etc.) would be appropriate. Any increase or decrease in the number of leachate extraction points in the system or changes in the LCS configuration or operational status would be done following consultation with District, the IEPA, and the U.S. EPA.

Table 1
Landfill Gas Extraction Well System Adjustment Schedule

OXYGEN (% V)	METHANE (% V)	BALANCE GAS OR NITROGEN (% V)	ACTION	STATUS
<2.0	>50	<4	Increase vacuum.	Below optimum extraction
<2.0	40 < CH_4 <50	<4	Maintain same vacuum, unless LFG migration is detected in the area of the well, then increase vacuum.	Well most likely at optimum extraction
2 < O_2 <4	>50	4 < BG or N <8	Open or maintain vacuum, watching for oxygen rise; and check cover/wellhead integrity.	Below optimum extraction and possible air intrusion
2 < O_2 <4	40 < CH_4 <50	4 < BG or N <8	Maintain vacuum, watching for oxygen rise; and check cover and wellhead integrity; watch for sharp temperature increases.	Optimum production, and possible air intrusion, which may lead to damage to microbes, and decrease in methane
2 < O_2 <4	<40	4 < BG or N <8	Decrease vacuum, watching for oxygen rise; and check cover and wellhead integrity; watch for sharp temperature increases, unless LFG migration is detected, then keep vacuum the same.	Well overdrawn, air intrusion, and possible damage to microbes
>4.0	>40	>8	Maintain vacuum, check cover and wellhead integrity, make repairs if necessary, and watch for oxygen rise. Shut well if oxygen is greater than 10 percent; watch for sharp temperature increases.	Air intrusion and damage to microbes
>4.0	<40	>8	Throttle back or close well, and watch for oxygen rise. Shut well if greater than 10 percent oxygen. Check cover and wellhead integrity, and watch for sharp temperature increases.	Air intrusion and damage to microbes

Note:
The vacuum should be greatest at the blower inlet and lowest at the farthest monitoring point of the LFG header pipe collection system.

Table 2
Maintenance Schedule Summary

EQUIPMENT/ACTION	WK	MO	QTR	6 MO	YR	AS NEEDED
Landfill Cover						
1. Inspect for leachate seeps.		X				
2. Inspect for vegetation stress.			X			
3. Inspect for erosion.			X			
4. Inspect condition of vegetation.			X			
5. Inspect for ponding of surface water			X			
6. Mow/Cut vegetation on an as-needed basis, but at least annually.					X	
7. Reseed or regrade.						X
8. Correct differential settlement.						X
Site Security						
1. Inspect security fencing and signage.			X			
2. Lubricate locks.					X	
Leachate Pumps						
1. Verify pump operation (frequency may be adjusted after the first year).		X				
2. Inspect flow meters and cycle counters.		X				
3. Remove pump and inspect for damaged tubing and general condition.				X		
4. Clean pumps of corrosion and buildup of biological growth (or as needed).				X		X
5. For winterization, blow out compressed air lines to remove any accumulated water.					X	
Leachate Storage Tank and Loadout Area						
1. Check for leaks, visible damage, or corrosion.		X				
2. Inspect circulation pump (during operation).			X			
3. Inspect hi-level float.		X				
4. For winterization: Pump leachate tank more frequently to prevent freezing. Turn on the leachate circulation pump and maintain according to the manufacturer's recommendations. Turn on heat tracing.					X	
6. Mow or cut vegetation.						X
LFG and Leachate Extraction Wells						
1. Inspect for settling, weeds, and debris. Remove weeds from around vaults.		X				
2. Inspect integrity of hardware, locks, pipes, and valves.		X				
3. Inspect integrity of vaults.		X				
4. Clean out siltation in wells.						X
Extraction System Piping						
1. Inspect for settling, weeds, leaks, water.			X			
2. Inspect for surging of condensate.			X			
Condensate Driplegs						
1. Check for leaks in top caps.			X			
2. Inspect for proper liquid level in U-trap and add liquid as necessary.			X			

Table 2 (continued)
Maintenance Schedule Summary

EQUIPMENT/ACTION	WK	MO	QTR	6 MO	YR	AS NEEDED
Blower Facility						
1. Inspect piping, fittings, valves, and seals for leaks or breakage.		X				
2. Check for loose connections or vibration at blower.		X				
3. Check operation of the fail-closed valve.			X			
4. Lubricate blower motor bearings.			X			
5. Lubricate blower bearings.			X			
6. Check motor/blower alignment.				X		
7. Tighten electrical connections on motor control panel and at motor.					X	
8. Check and repack blower bearing housing.					X	
9. Clean blower.						X
10. Winterization: Install/check heat tracing for deterioration and replace; power heat tracing during cold periods.					X	X
Air Compressor and Dehydrator System						
1. Fluid level inspection.		X				
2. Check relief valve.		X				
3. Check for leaks.		X				
4. Check compressor electric drain – test valve.		X				
5. Clean filter screen.		X				
6. Change compressor oil (annually, if synthetic lubricant is used).			X			
7. Air filter replacement.					X	
8. Change dryer air filter.					X	
9. Dry Desiccant replacement (see manufacturer's data).						X
Flares						
1. Inspect igniter for proper operation.		X				
2. Clean surface of solar panel.		X				
3. Check all ignition and ground wire terminals & connections for security.		X				
4. Check solar blower operation and connections (UAV-4 only)		X				
5. Remove weeds or debris.			X			
6. Check igniter or any carbon buildup and proper gap. Check electrodes.				X		
7. Clean flame arrestor.					X	
8. Check Thermocouple.					X	
9. Winterization: Install/ check heat tracing for deterioration and replace; power heat tracing during cold periods.					X	X

Table 3
Landfill Gas Collection System Troubleshooting Checklist

SYMPTOM	POSSIBLE CAUSE	DETERMINATION OF CAUSE	TEMPORARY SOLUTION	LONG-TERM SOLUTION
Vertical extraction well high oxygen/ nitrogen concentration	1. Loose or leaky test port connection	1. If the plastic tube fits loosely on the quick connect coupling or does not affect a positive seal,	1. Use Teflon tape liberally to effect a better seal.	1. Plug and redrill test port.
	2. Bad or loose hose connection with meter	— check hose connection, and	2. Fix hose connection.	2. Fix hose connection.
	3. Bad/leaky gasket at wellhead or valve	— check gasket and flange or fernco.	3. Place duct tape around the flange.	3. Replace gasket.
	4. Bad well seal	4. None of the above causes were found—historically a good well.	4. Adjust valve setting lower or shut off.	4. Repack or rehydrate wellhead seal with bentonite.
	5. Overdrawing on the well	5. None of the above causes were found. Check cover integrity.	5. Adjust valve setting lower or shut off.	5. Repair cover, add pipe boot around well, or none; well may be past maximum production.
Low methane concentration (<40%)	1. Air leak	1. See high oxygen/nitrogen concentration troubleshooting.		
	2. Overpulling on the well	2. Check well's past history of typical vacuums.	2. Adjust valve setting lower.	2. Check well reading in next monitoring event.
High nitrogen/ balance gas (>10%)	1. Air leak	1. See high oxygen/nitrogen concentration troubleshooting.		
	2. Overpulling on the well	2. Check well's past history of typical vacuums.	2. Adjust valve setting lower.	2. Check well reading in next monitoring event.
Fluctuating static/delta pressure readings "Surging"	1. Partial condensate blockage in lateral	1. Listen to well lateral for surging of LFG or gurgling of condensate.	1. If significant, shut off well and drain condensate.	1. May need to regrade lateral.
	2. Main header pipe partially blocked by condensate	2. Listen for surging or gurgling of condensate; check for differential settlement between header and sump.	2. Check operation of nearest condensate sump, or repair drain line from header to sump.	2. May need to regrade header or inspect drip leg.
Low flow from well	1. Significant leachate in well restricts LFG flow	1. Check liquid level and leachate pump.	1. Continue to pump liquid from well.	1. None.
	2. Waste decomposed	2. Check waste placement records.	2. None.	2. None.
	3. Well screen clogged	3. Televise well screen.	3. None.	3. Abandon well, and replace with a new well.

Table 4
Blower Troubleshooting Summary

BLOWER/SYMPTOM	ACTION
1. Insufficient pressure or vacuum	▪ Check rotation and speed. ▪ Inspect piping for blockage and leaks. Check all inlet and outlet valves. ▪ Check motor load (amp). Motor should not be operating beyond rating. ▪ Check rubber sleeve or inlet for collapse. ▪ Clean flame arrestor.
2. Vibration and noise	▪ Check alignment between blower and motor. ▪ Restore proper alignment (if necessary) immediately to prevent damage to bearings or drive. ▪ Inspect bearings for wear or damage. ▪ Replace if necessary. ▪ Blowers will surge when operating under very light or no load. Increase airflow in this case. ▪ Never run blowers continuously with the valves closed or if in a surge condition. ▪ Check for blockage in piping and blower.
3. Blower overheated	▪ Check for surge or inadequate airflow.
4. Bearing housing overheated	▪ Inspect for damaged bearings. ▪ Check for high ambient temperature.
5. Motor overheated	▪ Check for overload or bearing failure. ▪ Be sure that voltage is correct and balanced. ▪ Look for shorted windings. ▪ Check for high ambient temperature.
6. Surge (“unstable” flow of air through machine)	▪ Check for restricted air piping. ▪ Inspect outlet piping for blockage.

Table 5
Flare Station Troubleshooting Checklist

SYMPTOM*	POSSIBLE CAUSE	DETERMINATION OF CAUSE	TEMPORARY SOLUTION	LONG-TERM SOLUTION
Loss of ignition	1. Blower malfunction	1. See Table 4.	1. See Table 4.	1. See Table 4.
	2. Methane concentrations less than 30%, oxygen >10%	2. Check access port between blower and flare. Check flow rate and gas concentration to confirm that they are within the design parameters of the flare.	2. Verify readings. Obtain a complete set of extraction well monitoring data.	2. Adjust wellfield in accordance with Section 3.
	3. Thermocouple failure	3. Check PLC/user interface for temperature data. Visually inspect thermocouple and wiring. Check to see if the thermocouple is reading the approximate ambient temperature. Discontinuity of a thermocouple will cause a high temperature shutdown.	3. N/A.	3. Repair thermocouple or wiring.
	4. Sparker failure	4. Check condition of sparking plug. If ignition system is in good condition, test transformer for performance. If transformer is okay, check to see if ignition wire is broken. Dirt, residue, and carbon buildup may limit sparker ignition. Check to see if spark system is grounded (i.e., cracked insulators). Check for voltage from solar panel. Check battery voltage for 12V.	4. Clean spark plug. Clean igniter. If low voltage measured on the solar panel, clean and/or reposition solar panel. If low voltage measured on the battery, charge battery.	4. Repair/Replace igniter components. Replace battery if it no longer holds a charge.
Flare systems not operational	1. Loss of power	1. Check circuit breakers and power supply, and check for electrical short circuits	1. Reset circuit breakers, check electric service, eliminate electrical shorts.	1. Replace circuit breakers and repair wiring.

Table 6
Leachate Collection System Troubleshooting Checklist

SYMPTOM	POSSIBLE CAUSE	DETERMINATION OF CAUSE	TEMPORARY SOLUTION	LONG-TERM SOLUTION
Leachate pumps not operational	1. Insufficient air pressure	1. Verify by confirming liquid level in extraction well above pump start level or lack of pressure at wellhead. Verify pump is working by actuating pump manually. Check to see if air pressure regulator setting is too low. Check compressor.	1. Increase air pressure. Air pressure should be set between 40 and 100 psi.	1. Look for leaks to determine why air pressure was too low. Repair pump.
	2. Unable to discharge	2. Discharge valve or isolation valve on force main closed. Verify that pump is operational. Refer to pump manual for more information on troubleshooting the pump.	2. Check valve position at isolation valve locations. Valves should be open. Check discharge hose for correct set-up and discharge. Check force main for blockage or damage.	2. Check valve positions as part of regular maintenance. Replace exhaust hoses. Remove pump, inspect/ clean, check valve, clean pump by flushing with clean water, and reconnect pump. Replace pump if pump does not function after all described steps have been followed. Repair pump.

Table 6 (continued)
Leachate Collection System Troubleshooting Checklist

SYMPTOM	POSSIBLE CAUSE	DETERMINATION OF CAUSE	TEMPORARY SOLUTION	LONG-TERM SOLUTION
Collection tank circulation pump not operational	1. **REFER TO MANUFACTURER'S RECOMMENDATIONS.**			
	2. During cold periods, potential for freezing of collected leachate.	2. Check for freezing. Check inlet and outlet valves. Check heat trace.	2. Turn on heat trace.	2. Replace circulation pump. Replace heat trace.
Low flow from well	1. Leachate management maintenance elevation has been achieved.	1. None.	1. None.	1. None
	2. Pneumatic leachate pump not operating.	2. Refer to leachate pump symptoms above.	2. Refer to leachate pump symptoms above.	2. Refer to leachate pump symptoms above.
	3. Well screen is clogged.	3. Televise well screen.	3. Clean out screen with high pressure wash.	3. Abandon well, and replace with a new well.
	4. Silt has accumulated.	4. Lower probe down well and check total well depth. Pull sump and check condition.	4. Clean out well.	4. Abandon well, and replace with a new well.
Collection tank high level fault	1. Float switch is stuck.	1. Visually inspect.	1. Run pump manually or use vacuum truck.	1. Replace switch.
	2. Loadout frequency is not sufficient.	2. Compare loadout records versus frequency of high level alert.	2. Increase frequency of loadout.	2. Connect lateral to local sewerage district.

Table 7
Landfill Gas and Leachate Monitoring

MONITORING POINTS	PARAMETERS	FREQUENCY
Gas probes (GP-1, GP-2A, GP-2B, GP-3, GP-4A, GP-4B, GP-4C, GP-5, GP-6, GP-7A, GP-7B, GP-8A, GP-8B, GP-9A, GP-9B, GP-10A, GP-10B, GP-10C, GP-11A, GP-11B, GP-12, GP-13, GP-14, GP-15A, GP-15B, GP-16A, GP-16B, GP-16C, GP-17, GP-19, GP-20, GP-21A, GP-21B, GP-22A, GP-22B, GP-23A, GP-23B, GP-25A, GP-25B, GP-26A, GP-26B, GP-29A, GP-29B, GP-30A, GP-30B, GP-31A, GP-31B, GP-32A, GP-32B, GP-33A, GP-33B, GP-34A, GP-34B, GP-35A, GP-35B, GP-37A, GP-37B, G-113, G-116, MW-204D(East)[(1)]	Pressure, methane (CH_4), nitrogen (N, as a balance gas), oxygen (O_2), carbon dioxide (CO_2), and liquid level	Monthly for 1 year, at which time the frequency and number of monitoring points may be adjusted
Gas header at both blower flare locations	Pressure (pre and post-blower), CH_4, O_2, CO_2, balance gas, flow rate (scfm), and temperature	Monthly
Extraction wells (DV-1, DV-3, DV-6, DV-8, DV-12, DV-13, EWL-2, EWL-10, EWL-11, EWL-12, GEW-1, GEW-2, SV-12, UAV-1, UAV-2, UAV-6)	Pressure (header and well), CH_4, CO_2, O_2, flow rate (scfm), temperature, and liquid level	Monthly for 1 year, at which time the frequency may be adjusted
Leachate extraction wells (EWL-2, MH-2, SP1)	Leachate elevation level, total cycles	Monthly for 1 year, at which time the frequency may be adjusted

Note:
(1) Selected due to location, screened interval, and historical methane detections.

Figure 1
LFG and Leachate Monitoring Location Map

Appendix A
Landfill Gas Collection System Manufacturer's Information

Table of Contents

A1
Blower Flare System

A2
Wellheads, Valves

Appendix B
Leachate Collection System Manufacturer's Information

Table of Contents

B1
Pneumatic Pumps

B2
Compressor

B3
Air Filter

B4
Dessicant Dryer

B5
Moisture Indicator

B6
Miscellaneous Valves

B7
Leachate Loadout Pump

B8
Baker Frac Tank

Appendix C
Monitoring Inspection Forms

Facility Inspection Report
Mallard North Landfill
Hanover Park, Illinois

NOTE: Inspector using this form shall be familiar with Section 4 of the O,M&M Plan. Mark the location of any potential problems on the attached site map regardless if maintenance is required.

DATE:_____ INSPECTOR(S):_____

TEMPERATURE/WEATHER:_____

_____

GROUND CONDITIONS:_____

_____

ITEM	COMMENTS/OBSERVATIONS	Adequate	Requires Maintenance
Final Cover			
1.	Vegetation _____	☐	☐
2.	Erosion _____	☐	☐
3.	Burrowing _____	☐	☐
4.	Settlement _____	☐	☐
5.	Leachate seeps _____	☐	☐
6.	Other _____	☐	☐

ITEM	COMMENTS/OBSERVATIONS	Adequate	Requires Maintenance

Groundwater Wells/Gas Monitoring Probes

Describe below (see next page) the nature of any damage, deterioration, or vandalism observed and required maintenance. At a minimum, the following components of each well and probe shall be inspected: (1) protective casing; (2) well stick-up, cap, and conditions inside protective casing; (3) surface seal; (4) well I.D. label; (5) locks.

1. Identify well/probe number and problems observed, if any. _____ ☐ ☐

LFG and Leachate Extraction Wells

Inspect well assemblies for loose bolts, cracks in pipes, air or liquid leaks in pipes, broken valve controls, evidence of differential settlement (such as stretching of the flex hose), or other evidence of integrity failure. Describe the nature of any damage, deterioration, or vandalism observed and required maintenance. Identify the extraction well number for problems observed, if any.

1. Differential settlement _____ ☐ ☐
2. Hardware, pipes, and valves _____ ☐ ☐
3. Pump _____ ☐ ☐
4. Flow meters/cycle counters _____ ☐ ☐

ITEM	COMMENTS/OBSERVATIONS	Adequate	Requires Maintenance
5.	Leaks _____	☐	☐
6.	Other _____	☐	☐

LFG and Leachate Extraction System Piping

1.	Isolation valves _____	☐	☐
2.	Condensate surging _____	☐	☐
3.	Leaks _____	☐	☐
4.	Settlement _____	☐	☐
5.	Other _____	☐	☐

Drip Legs (DL-1, DL-2, DL-3)

1.	Leaks, sufficient water _____	☐	☐
2.	Other _____	☐	☐

ITEM	COMMENTS/OBSERVATIONS	Adequate	Requires Maintenance
Blower Facility (Northwest)			
1.	Piping, fittings, valves, seals	☐	☐
2.	Blower	☐	☐
3.	Pneumatic Actuator Valve/Exhaust fan	☐	☐
4.	Other	☐	☐
Flare (Northwest)			
1.	Flame arrestor	☐	☐
2.	Igniter	☐	☐
3.	Installation	☐	☐
4.	Solenoids	☐	☐
5.	Other	☐	☐

ITEM	COMMENTS/OBSERVATIONS	Adequate	Requires Maintenance
Blower Facility (Southcentral)			
1.	Piping, fittings, valves, seals	☐	☐
2.	Blower	☐	☐
3.	Pneumatic Actuator Valve/Exhaust fan	☐	☐
4.	Other	☐	☐
Flare (Southcentral)			
1.	Flame arrestor	☐	☐
2.	Igniter	☐	☐
3.	Installation	☐	☐
4.	Solenoids	☐	☐
5.	Other	☐	☐

ITEM	COMMENTS/OBSERVATIONS	Adequate	Requires Maintenance
Fencing and Signs (Northwest and Southcentral)			
1.	Fencing	☐	☐
2.	Gates and locks	☐	☐
3.	Signs	☐	☐
4.	Other	☐	☐
Access Roads			
1.	Accessibility	☐	☐
2.	Other	☐	☐

Maintenance Report
Mallard North Landfill
Hanover Park, Illinois

Prepared By: _____

Date Prepared: _____

Date(s) Maintenance Performed: _____

Name of Contractor(s): _____

_____

Type of Maintenance	Scheduled	Responsive	Nature of Work Performed/Location
☐ Groundwater well	☐	☐	
☐ Gas probe	☐	☐	
☐ LFG and leachate extraction wells		☐	
☐ LFG and leachate extraction system piping	☐	☐	
☐ Blower facility (NW)	☐	☐	
☐ Blower facility (South)	☐	☐	
☐ Flare (NW)	☐	☐	
☐ Flare (South)	☐	☐	
☐ Vegetation	☐	☐	
☐ Erosion control		☐	
☐ Settlement		☐	
☐ Access road	☐	☐	
☐ Fencing/Signs	☐	☐	
☐ Leachate seep		☐	
☐ Other		☐	

DETAILED DESCRIPTION OF MAINTENANCE PERFORMED:

(Attach additional pages if necessary and contractor's invoice with description of services rendered, if applicable).

Landfill Gas/Leachate Monitoring
Mallard North Landfill
Hanover Park, Illinois

Person(s) sampling: _____ Date: _____ Notes: _____

Ambient temperature: _____ °F

Barometric pressure: _____ in. Hg

Trend in barometric pressure: _____

Weather conditions: _____

Ground conditions: _____

Gas/O_2 meter model: _____ Serial #: _____

Date last calibrated: _____

BLOWER/FLARE DATA				
	NORTHWEST		SOUTHCENTRAL	
ITEM (UNITS)	INITIAL	POST	INITIAL	POST
Orifice DP (in H_20)				
Flow (scfm)				
Combustion temperature (°F)				
Blower inlet pressure (in H_2O)				
Blower outlet pressure (in H_2O)				
Blower valve setting				
Gas inlet temperature (°F)				
% CH_4				
% CO_2				
% O_2				

LEACHATE COLLECTION SYSTEM DATA
Leachate tank level _____ (Full, Half, Empty)
Compressor pressure _____ PSI
Notes: _____

BLOWER/FLARE DATA				
	NORTHWEST		SOUTHCENTRAL	
ITEM (UNITS)	INITIAL	POST	INITIAL	POST
% Balance gas				

LEACHATE COLLECTION SYSTEM DATA

Landfill Gas/Leachate Monitoring
Mallard North Landfill
Hanover Park, Illinois

LFG EXTRACTION WELL FIELD DATA

LOCATION	WELL-SIDE PRESSURE(1)		HEADER SIDE PRESSURE(1)		% CH_4	% O_2	% CO_2	% BAL.	TEMP.	ORIFICE PLATE DP(1)		VALVE % OPEN		LIQUID LEVEL (ft BTOC)
	I	P	I	P						I	P	I	P	
DV-1														
DV-3														
DV-6														
DV-8														
DV-12														
DV-13														
EWL-2														
EWL-10														
EWL-11														
EWL-12														
GEW-1														
GEW-2														
SV-12														
UAV-1														

UAV-2														
UAV-6														

Note:
(1) I = initial reading; P = post adjustments; NC = no change.

Landfill Gas/Leachate Monitoring
Mallard North Landfill
Hanover Park, Illinois

LEACHATE EXTRACTION WELL FIELD DATA

LOCATION	CYCLE COUNTS	TOTALIZER	LIQUID LEVEL (ft BTOC)
EWL-2			
MH-2			
SP1			

Note:
NR = not recorded, NC = no change.

Landfill Gas/Leachate Monitoring
Mallard North Landfill
Hanover Park, Illinois

GAS PROBE FIELD DATA

LOCATION	PRESSURE	% CH_4	% O_2	% CO_2	% BAL.	LIQUID LEVEL (ft BTOC)	NOTES
GP-1							
GP-2A							
GP-2B							
GP-3							
GP-4A							
GP-4B							
GP-4C							
GP-5							
GP-6							
GP-7A							
GP-7B							
GP-8A							
GP-8B							
GP-9A							
GP-9B							
GP-10A							
GP-10B							

Landfill Gas/Leachate Monitoring
Mallard North Landfill
Hanover Park, Illinois

GAS PROBE FIELD DATA (cont.)

LOCATION	PRESSURE	% CH_4	% O_2	% CO_2	% BAL.	LIQUID LEVEL (ft BTOC)	NOTES
GP-10C							
GP-11A							
GP-11B							
GP-12							
GP-13							
GP-14							
GP-15A							
GP-15B							
GP-16A							
GP-16B							
GP-16C							
GP-17							
GP-19							
GP-20							
GP-21A							
GP-21B							

GP-22A							

Landfill Gas/Leachate Monitoring
Mallard North Landfill
Hanover Park, Illinois

GAS PROBE FIELD DATA (cont.)

LOCATION	PRESSURE	% CH_4	% O_2	% CO_2	% BAL.	LIQUID LEVEL (ft BTOC)	NOTES
GP-22B							
GP-*23A*							
GP-23B							
GP-25A							
GP-25B							
GP-26A							
GP-26B							
GP-29A							
GP-29B							
GP-30A							
GP-30B							
GP-31A							
GP-31B							
GP-32A							
GP-32B							

GP-33A							
GP-33B							

Landfill Gas/Leachate Monitoring
Mallard North Landfill
Hanover Park, Illinois

GAS PROBE FIELD DATA (cont.)

LOCATION	PRESSURE	% CH_4	% O_2	% CO_2	% BAL.	LIQUID LEVEL (ft BTOC)	NOTES
GP-34A							
GP-34B							
GP-35A							
GP-35B							
GP-37A							
GP-37B							
GP-113							
GP-116							
MW-204D(East)							

Incident Report
Mallard North Landfill
Hanover Park, Illinois

Person reporting incident: _____ **Date:** _____

Date of incident: _____ **Time of incident:** _____

Description of incident: _____

Names of personnel involved: _____

Types of equipment involved: _____

Summary of actions taken: _____

Required follow-up: _____